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OCEANOGRAPHIC CONDITIONS AND THE ALBACORE FISHERY EAST OF CAPE NOJIMA

A translation

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Explanatory Note

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Washington, D.C.
July, 1952

United States Department of the Interior, Oscar L. Chapman, Secretary
Fish and Wildlife Service, Albert M. Day, Director

OCEANOGRAPHIC CONDITIONS AND THE ALBACORE GROUNDS EAST OF CAPE NOJIMA

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The albacore began to be regarded as of some importance around 1930, that is at about the time when it began to be exported to America as frozen fish or canned in oil. Before that time in Japan, the albacore was extremely unpopular, having a poor flavor when dried and being deficient in fat and tasteless when eaten fresh. The fishermen avoided schools of albacore, preferring to pursue the skipjack schools, and the price of this fish was very low, sometimes as low as 30 sen for a fish of about 25 pounds weight. Now with the sudden change in circumstances, the price of this fish has gone so high that many fishermen have the taking of albacore as their chief objective, to such an extent that whether or not they have a good skipjack season depends largely on how many albacore they take during the course of the season. This refers to the so-called summer fishery, in which the albacore are taken by pole and line along with the skipjack, the winter fishery being that in which they are taken on tuna longlines together with spearfishes, big-eyed tuna, and yellowfin tuna. The catch figures for the winter fishery have shown a tendency to increase steadily from year to year, however, the catch in the summer fishery in recent years has been gradually declining up until 1938, in which year the fishery showed renewed activity. The problems facing this fishery, the product of which occupies such an important place among our fisheries exports, should be the subject of basic investigations designed to clarify the migrational patterns and the reasons for fluctuations in the catch of this fish. The purpose of the present paper, like the previously published paper on the skipjack, is to put on record for future reference and for the information of fishermen in this prefecture, data from the researches of this Station and other data extracted from reports of the national Fisheries Experiment Station concerning the relationship between fishing conditions and oceanographic conditions in the albacore fishery.

I. Fluctuations in fishing conditions.

a. Fishing seasons

The fishing seasons are clearly divided into a so-called summer fishery and a winter fishery. The summer fishery is carried on from the latter part of April to July, its peak being from about the middle of May to the middle of June. The catch during this period almost invariably determines the success of the summer fishery. The winter fishery extends from the middle of October to early April, its peak being from December to February.

b. Fishing conditions in the summer and winter fisheries.

As the following table shows, the summer fishery had year by year shown a decline in its total catch until 1938, in which year it took a turn for the better. The catch of the winter fishery has, on the other hand, shown a tendency to increase from

year to year. Until 1935 the summer fishery overshadowed the winter fishery, but from 1935 on, the winter fishery was clearly preponderant, and the summer fishery was relegated to second place. As was stated earlier, the summer fishery is carried on in conjunction with the skipjack fishery, and its fishing grounds hardly change at all from year to year, being generally within about 500 miles from the coast. Compared with the winter fishery, the total number of vessels engaged is larger, despite which fact the total catch has gradually decreased. This is because the fishing grounds of the winter fishery have gradually been pushed farther and farther east from year to year into the waters where the albacore are, while the fishing grounds of the summer fishery have remained fixed within the range of the skipjack fisheries with no extension of the fishing grounds. In addition, it is thought that in recent years there has been a great change in the migration of the summer albacore which are taken on the skipjack fishing grounds. It should be noted that beginning about 1933, a large number of very small fish about 8 pounds in weight (including quite a number of around 6 pounds in weight) began to be taken.

Albacore Catch of Japan
/1 ton (2,000 lbs.) = 242 kan/

Year	Winter Fishery (October to April)	Spring Fishery	Totals	Percentage of Spring Catch in Total
	tons	tons	tons	
1931	8,000	12,000	20,000	60
1932	6,930	8,910	15,840	57
1933	7,725	9,712	17,437	56
1934	5,181	7,376	12,557	59
1935	11,971	4,816	16,787	29
1936	9,000	1,600	10,600	15
1937	14,000	804	14,804	6
1938	1/ 13,300	1/ 9,420	1/ 22,720	1/ 42

1/ Approximate figures.

Presented next for reference is a table of yearly landings at the port of Misaki in Kanagawa Prefecture, the port at which is landed most of the albacore taken by vessels from Miyagi Prefecture. It is well known that the port of Misaki together with the ports of Shizuoka Prefecture, are the most important places for the landing of albacore in Japan. It appears that the increase from year to year in the landings from the winter fishery at the port of Misaki is due to the extension of the fishing grounds to the east of Cape Nojima as well as to an increase in the number of fishing boats based at this port.

Albacore Landings at the Port of Misaki
/1,000-kan units converted to short tons/

Year	October to April	May to September	Totals
1929	1,915	831	2,746
1930	2,692	2,001	4,693
1931	6,575	2,059	8,634
1932	4,152	2,150	6,302
1933	4,693	3,986	8,605
1934	4,648	3,296	7,943
1935	6,141	2,601	8,741
1936	5,111	1,133	6,244
1937	8,932	248	9,180
1938	6,074	5,483	12,306

The reasons for the particularly abrupt decline in the catch of the summer fishery in 1936 and 1937 have been very loudly debated, however, as little basic research had been done at that time, it was only possible to listen to the advocates of the over-fishing theory, the cyclical theory, the abnormal oceanographic conditions theory, etc. In 1938, fishing became so good as to be comparable to the catch for 1933, and much of the anxiety of those engaged in the fishery disappeared, however, some of the

fishermen hoped to maintain liaison with the Fisheries Experiment Station in the future, supplying data and supporting basic investigations. Note: We commonly divide the tunas into the 5 following varieties — black tuna, big-eyed tuna, yellowfin tuna, spearfishes, and albacore. Some brief comment will be made on each of these:

(1) Black tuna (kuromaguro, maguro, kuroshibi; young fish are called kuromeji.) Large fish weigh from 400 to 500 pounds, rarely to 575 or 650 pounds. They occur over a broad area from Hokkaido to the Kuriles, and from the South Seas to the Japan Sea. In the North Pacific, they are taken from early summer through to winter, while in the Japan Sea area, the summer and winter are the best fishing seasons.

(2) Big-eyed tuna (mebachi, bachi; young fish are called bachi meji or daruma.) Large fish attain a weight of 250 pounds. This fish is taken to some extent everywhere in the Pacific south of about 36° to 37°N. latitude but it is not very numerous in the north.

(3) Yellowfin (kihada; young are called kimeji.) This species weighs from 40 - 50 pounds to 125 - 130 pounds. Its distribution is about the same as that of the big-eyed tuna, being numerous in the South Pacific and the Indian Ocean. This is the most important species in the tuna fishery of the South Seas.

(4) Spearfishes (kajiki). There are a number of varieties such as the striped marlin, broadbill, sailfish, black marlin, and white marlin. Except for the broadbill, these fish are taken in greatest numbers in the warm seas of the South. The broadbill has in recent years become an important object of fishing in this prefecture.

(5) Albacore (binnaga, tonbō, binchō.) Those taken are for the most part from 15 to 25 pounds in weight, but small fish of 6 to 7 pounds and large ones of about 100 pounds are also seen. This species is ordinarily taken from the waters east of Kinkazan to about 25°N. latitude from November to July of the following year. (Not many are taken in April or from August to October.)

II. Fishing grounds and oceanographic conditions.

(1) Concerning the summer fishery

(a) Oceanographic conditions and coastal fishing grounds

As was stated earlier, the summer fishery for albacore by fishing vessels from this prefecture is carried on in conjunction with the skipjack fishery, and for this reason its fishing grounds do not ordinarily extend beyond the range of the skipjack grounds. Before the development of the winter albacore fishery, these were the only albacore grounds to which any importance was given. From 1935 to 1937 (particularly in 1937) the value of these fishing grounds decreased sharply, quickly arousing the concern of persons engaged in the fishery. Some pessimists feared that the fishery might die out altogether, but a natural revival of the fishery in 1938 brought back their former value to these grounds. The coastal fishing grounds have thus undergone a remarkable rise and decline, but the question of the movements of these fishing grounds and their relation to oceanographic conditions remains. As has been stated a number of times previously, these fishing grounds fall within the sphere of the skipjack grounds. The fishing season is short, being only 3 months, from the end of April to July. This is not a well-rounded study, but the general outline of the fishery is roughly as follows:

Range of water temperatures within which catches are made -- 18° to 24°.

Area of good fishing grounds -- from 30° to 36° N. latitude and from 140° to 152° E. longitude.

Range of favorable water temperatures -- 19° to 23°.

Period of greatest catch -- from middle of May to middle of June.

The fishing grounds first appear in April about 150 to 450 miles east of Cape Nojima. (The first catches are sometimes made in the middle of March in the vicinity of Hachijōjima and Aogashima, but ordinarily no fish are caught in this vicinity after the first of April.) In May the albacore appear in the coastal waters around Cape Nojima, and in June and July they pass northeastward through the coastal waters of the Bōsō region and disappear, only a very few of them appearing in the Northeastern Sea Area in August and September. (Of course, this description does not obtain for years like 1937, when the summer albacore fishery presented abnormal conditions.)

The favorable water temperatures throughout a number of years were from 20 to 21 degrees, and about 50 to 80 percent of the total catch was taken at these water temperatures. The next most favorable temperatures were in the order of 22°, 19°, and 23°. In terms of salinities, the greatest catches were centered around salinities of 34.8 0/00. As the table shows, surface water temperatures of 21° appear in the early and middle part of June and coincide with the favorable water temperature for skipjack in the same period. The best fishing grounds, just as in the case of skipjack, are found along current boundaries. Almost all of the catch is composed of medium sized (25 to 45 pounds) and small (under 25 pounds) fish.

(b) Oceanographic conditions and offshore fishing grounds

The following remarks are based on the results obtained in the course of two cruises in the summer albacore fishery from May 10 to September 2, 1937, by the Fuji Maru of the Shizuoka Prefecture Fisheries Experiment Station. This was the first vessel in Japan to attempt summer albacore fishing in the offshore waters. In 1938, with the support of the Ministry of Agriculture and Forestry, the fisheries experiment stations of Aomori, Iwate, Miyagi, Fukushima, Chiba, Shizuoka, Mie, Wakayama, Aichi, and Kanagawa prefectures surveyed the summer albacore longline fishery in the area between 170°E. longitude and 160° W. longitude, 10° N. latitude to 35° N. latitude. Leaving the results obtained by this Station for future publication, the following is based on the surveys carried out by the Shizuoka Prefecture Fisheries Experiment Station.

Area surveyed

First cruise -- 160° to 180° E.
30° to 34° N.

Second cruise -- 165° E. to 177.5° W.
29° to 41° N.

Survey period

First cruise -- May 10 to June 25.

Second cruise -- June 24 to September 2.

Fishing gear and bait

Longlines -- 120 baskets
Poles -- 30
Trolling lines and hand lines
Salted sardines, frozen squid, frozen mackerel, and live sardines.

Fishing Grounds and Surface Water Temperatures (in 1932, a moderately good year)

Item \ 10-day period	May			June			July		
	First	Second	Third	First	Second	Third	First	Second	Third
Favorable temperatures	19°-20°	19°-20°	19°-20°	21°-22°	21°-22°	21°-22°	22°-23°	23°	---
Most favorable temp.	19°	20°	20°	21°	21°	22°	22°	23°	---
Percentage of the catch made during this month and center of the fishing grounds	32% 142°E 33°N			65% 145°E 34°N			approx. 2% 151°E 34°N		

Catch

First cruise -- albacore 116 (20 to 35 pounds), big-eyed tuna 23, striped marlin 7, sailfish 2, yellowfin tuna 3.

Second cruise -- albacore 285 (30 to 60 pounds), black marlin 7, striped marlin 3, yellowfin tuna 6.

The vertical temperature differential was much greater than in the winter fishery, being particularly marked on the second cruise (see the following table).

Comparative Table of Summer and Winter Water Temperatures on the Albacore Grounds (35°N, 174°E)

Depth	Winter Fishery (December)	Summer Fishery (First Cruise)	Summer Fishery (Second Cruise)
Surface	18.9°	18.9°	24.8°
50 m	18.8°	17.0°	17.6°
100	17.8°	15.9°	16.6°
200	16.2°	14.6°	13.8°

During the winter the difference between the surface temperatures and the temperature at 100 meters does not exceed 1.1° and the difference between the surface and 200 meters is not greater than 2.7°. On the first cruise, however, there was a difference of 3° between the surface temperature and the temperature at 100 meters, and a difference of 4.3° between the surface and 200 meters. On the second cruise, there was already a difference of 7.2° at 50 meters, 8.2° at 100 meters, and 11° at 200 meters. Such a great vertical differential in water temperature is generally regarded as unfavorable for tuna longline fishing. (In the course of this same survey, where good fishing was found on the first cruise the difference between water temperatures at the surface and at 100 meters was 3°, and the difference between the surface and 200 meters was 4.4°. Where no fish at all were caught, there was a difference of 4° between the surface and 100 meters, and 6.5° between the surface and

200 meters. Furthermore, when the catch is good in the winter fishery, the vertical difference in water temperature is slight, being on the order of 1° between the surface and the 100 meter level, and 3° at the most between the surface and 200 meters.)

Notes:

(1) At the time of the second cruise, there were many skipjack schools up to 300 miles east of Kinkazan, but there were no schools to be found from 500 to 1,000 miles off the coast. About 1,300 miles out (165°55'E., 40°54'N.) a large school of skipjack accompanied by birds was met with, and in 45 minutes in the evening, 4,000 fish weighing 7 pounds apiece was taken (by about 15 men). Water temperatures at this time showed a great vertical differential, being 19.4° at the surface, 11.4° at 50 meters, 10.1° at 100 meters, 8° at 200 meters, and 5° at 500 meters.

(2) On the same cruise, a large school of albacore was encountered at 177°28'W., 29°11'N., and in 1 hour at sunset, 283 large albacore (largest 60, smallest 35, average 45 pounds) were taken by only 7 teams of fishermen.

(3) The fishing gear used on this voyage had, per basket, 240 fathoms of main line, 10 branch lines (two of them of 15 fathoms and eight of 7 fathoms), a float line 20 fathoms in length, and a glass float attached in the middle of the basket of line.

To summarize the foregoing, at this season schools of albacore have not been seen west of longitude 177°E., but albacore have been taken to the eastward from the latter part of May to the middle of August. It is expected that the farther east one goes, the better the fishing will be, particularly to the north and east of Midway I., where it is expected that there will be schools of large albacore. In areas in the vicinity of this island, where water temperatures were about 26°, there were a great many big-eyed tuna and skipjack. The skipjack did not bite well, perhaps because of an abundance of natural feed, but the big-eyed tuna appeared to be rather promising.

To summarize, in the vicinity of the winter offshore fishing grounds, fish of the same type as the winter albacore are still present from the latter part of May to June. Around the middle of August in the vicinity of Midway Island, with

surface water temperatures at about 26°, big schools of large albacore occur, it is believed for spawning purposes. These fish could be taken on pole and line gear, they took to the bait splendidly, and no difficulty was experienced in transporting live sardines. It is believed that a good deal of skipjack and big-eyed tuna can also be taken in this vicinity. Fishing boats which attempt to operate in this area at this season must, of course, have adequate insulation and refrigeration machinery, and reliable celestial navigation is also essential. The condition of the fish and their spawning seasons are problems particularly worthy of attention. The Shizuoka Prefectural Fisheries Experiment Station has made a study of the condition of the albacore taken on both these cruises, and the results are said to have shown that the fish from the second cruise were decidedly superior.

The fish from the first cruise weighed from 20 to 30 pounds, the average being about 25 pounds, while those taken on the second cruise weighed from 30 to 60 pounds with the average over 40 pounds. Thus, the albacore taken on the first cruise were far smaller. The condition factor for fish from the first cruise averaged 23.2, while for fish from the second cruise it averaged 25.5. With respect to the quality of the meat, the fish taken on the first cruise were somewhat inferior to fish taken during the summer in coastal waters, and the stage of development of the gonads was not much different from that of fish taken in the winter fishery during the latter part of March. By contrast, the flesh of the albacore from the second cruise was the best that had ever been seen. Their gonads were very well developed. Ordinarily, the gonads of one albacore weigh from about 10 grams to 18 grams, but in the case of these fish the average was about 165 grams. At present, the spawning season and spawning grounds of the albacore are said to be unknown, however, judging by these circumstances it is deduced that a part of them may spawn in the vicinity of Midway Island at water temperatures of 26° to 27° around the early part of October (the spawning season is generally considered to be from about October to December). It is assumed that the spawning fish weigh 50 or 60 pounds and that they lay more than 300,000 eggs at a time. It appears that the eggs float separately. These notes are recorded here as a problem for future research.

(2) Concerning the winter fishery

(a) Oceanographic conditions and the coastal fishing grounds

These have been in the past the fishing grounds of the longline fishery, and they are separate from the offshore grounds of the winter season. The fishing grounds first

appear around the middle of October, far to the east of Kinkazan and move day by day to the south, with the fishing improving steadily. Generally from November to January there are good fishing grounds from 250 to 600 miles east of Kinkazan and Cape Nojima. Ordinarily these grounds appear in February from 200 to 600 miles to the SE and SSE of Cape Nojima, and in March, they are usually 300 to 500 miles SE of Cape Nojima. At times, however, there may be two centers of fishing grounds in the same month. The peak of the season is usually in January and February, although in some years very good fishing is had in December or in March. After the first of April the catch declines sharply, in part because the fishermen at this time turn to the skipjack fishery.

Considering next the relationship between water temperature and fish catch, in October at temperatures of 22° to 23° some fish are taken but the amount is inconsiderable. In November 19° is considered the most favorable temperature, and from December to March, the period including the peak season of the fishery, the most favorable fishing temperatures are everywhere centered around 18°. A general outline of this relationship is shown as follows:

(Example drawn from the winter of 1931 to the spring of 1932)

Range of water temperatures at which fish are taken -- 15° to 23°

Range of location of good fishing grounds -- 142° to 151°E., 30° to 37°N.

Range of favorable water temperatures -- 17° to 19°

Season of greatest catch -- January and February

There appears to be little variation in the relationship between fish catch and water temperature from year to year. (Considering the movements of the fishing grounds as a whole, they are at their farthest south in March, there thus appearing to be a close relationship between the movements of the isotherms centered around 18° and the movements of the fishing grounds.)

(b) Oceanographic conditions and the offshore fishing grounds

The Kanan Maru of this prefecture sailed from Ajihama January 5, 1932 and fished in the vicinity of 152°40' to 157°E. longitude, 31°28' to 33°15'N. latitude. This vessel took 99 albacore, 67 big-eyed tuna, 11 large skipjack, 5 striped marlin,

4 broadbill swordfish, 1 yellowfin tuna, and a large number of sharks, and returned to port on January 21, the first vessel from this prefecture to engage in fishing in this area. Since that time with the increase in the number of large vessels, the fishing grounds have expanded and moved farther offshore year by year, the center of the winter albacore fishery in particular having moved to far distant waters. The following table will show this expansion and removal of the fishing grounds from 1931 on. This eastward movement of the winter fishing grounds almost ceased after 1936, and the fishing grounds remained the so-called 1000-mile and 2000-mile grounds in the vicinity of 26° to 33°N., along the line of the current boundary (subtropical line of convergence) formed by the meeting of the Kuroshio countercurrent, which splits off to the southward from the main Kuroshio and the current running to the northwest along the northern fringe of the North Equatorial Current. The area which forms the center of the fishing ground is at 170° to 180°E. longitude, west of Midway Island, an area where the meeting of these currents is most pronounced (with high salinities of 35.5 and upwards). Tuna fishermen already knew from experience that good fishing grounds of restricted extent could be found in this sea area where changes in water temperatures and salinities were sharpest. Although it has been stated that the fishing grounds are now stationary, the center of the grounds moves a little bit south from January to February and from February to March, and the fishing grounds are at their farthest south position in March when the 18° isotherm also reaches its southernmost position. Favorable water temperatures are the same as in the coastal fishing grounds, 17° to 19° with 18° as the center. The fishing season is roughly from November to March, with the peak from around the middle of January to the middle of March.

Note:

(1) In 1938, the favorable water temperatures in the winter were from 17° to 19°.

(2) For the catch taken during the winter season see the section on fluctuations in fishing conditions.

As can be seen from the table, the greatest number of fish are taken in the winter season at surface water temperatures ranging from 17° to 19°, centering around 18 degrees. With respect to salinity, aside from a peak at around 34.6 to 34.9 0/00, the greatest number of fish is taken at 35.5 0/00 or higher. The fish are medium-sized (25 to 40 pounds), small (under 25 pounds), and some large ones (over 40 pounds) are also taken.

Year-by-year Extension and Eastward Movement

of the Winter Albacore Offshore Fishing Grounds

Fishing Ground / Year	Extent of the Fishing Grounds		Area of Greatest Catch		Notes
	North Latitude	East Longitude	North Latitude	East Longitude	
1931	36° - 39°	145° - 150°	36° - 38°	146° - 148°	
1932	30° - 39°	145° - 157°	34° - 39°	148° - 153°	
1933	31° - 39°	150° - 164°	31° - 39°	151° - 157°	and 161° - 163° (December)
1934	28° - 39°	155° - 170°	32° - 37°	163° - 169°	
1935	29° - 39°	158° - 175°	31° - 38°	165° - 175°	
1936	26° - 38°	158° - 178°	27° - 35°	161° - 176°	
1937	25° - 40°	160° - 180° and farther offshore	27° - 39°	163° - 176°	
1938	26° - 41°	158° - 179°	27° - 38°	162° - 176°	

Coastal Fishing Grounds for Winter Albacore and Surface Water Temperatures

(off Kinkazan and Cape Nojima)

Time	Center of Fishing Grounds		Scope of Fishing Grounds		Temperatures at Which Catches Were Made	Spread of Temperatures	Most Favorable Temperatures
Nov. 1931	147°E 151°E	37°N 37°N	146°E 35°N	155°E 40°N	16° - 23°	7°	19°
Dec. 1931	147°E	37°N	144°E 33°N	156°E 41°N	15° - 22°	7°	18°
Jan. 1932	150°E	36°N	145°E 32°N	158°E 36°N	16° - 20°	4°	18°
Feb. 1932	149°E 142°E	32°N 31°N	141°E 27°N	158°E 37°N	16° - 20°	4°	18°
Mar. 1932	144°E	30°N	140°E 24°N	156°E 36°N	15° - 22°	7°	18°
Apr. 1932					16° - 19°	3°	18°

Note: There was only a very small catch in October.

Note: Most of the albacore landed at Misaki are 4, 5, and 6-year-old fish. The 4 and 5-year-old fish fall within the "small" category as defined above, but the 6-year-old fish are medium-sized albacore.

III. Some thoughts on the migrations of the albacore

Taking into account differences in the relationships between fishing grounds and ocean currents and seasonal and regional differences in the water temperature and salinity of the fishing grounds, and the size of the fish, and utilizing data gathered by the fisheries experiment stations of various regions, Technician Uda of the National Fisheries Experiment Station has put forth the following working hypothesis with regard to the migrations of the albacore. It is recorded here in rough outline to serve as a reference for future investigators.

(1) Schools may pass back and forth between the coastal population and the offshore population, but at present it is most reasonable to consider these as two separate stocks.

(2) The coastal population consists of its own peculiar stock (medium and small albacore) and schools (small and medium fish) which enter it from the offshore waters.

(3) The offshore population consists of its own peculiar stock (large, medium, and small fish), and of schools, mainly medium-sized fish (including a certain number of small fish), which enter it from the coastal waters.

The numbers in which these albacore migrate affect the success of the fishery for the year.

(4) Recently the stock peculiar to the coastal waters and the amount of fish entering this stock from elsewhere have declined in numbers.

(5) The stock peculiar to the offshore waters and the recruitment into that stock from the coastal waters may be decreasing, however, there are no signs of a decrease as marked as that which has taken place in the coastal areas.

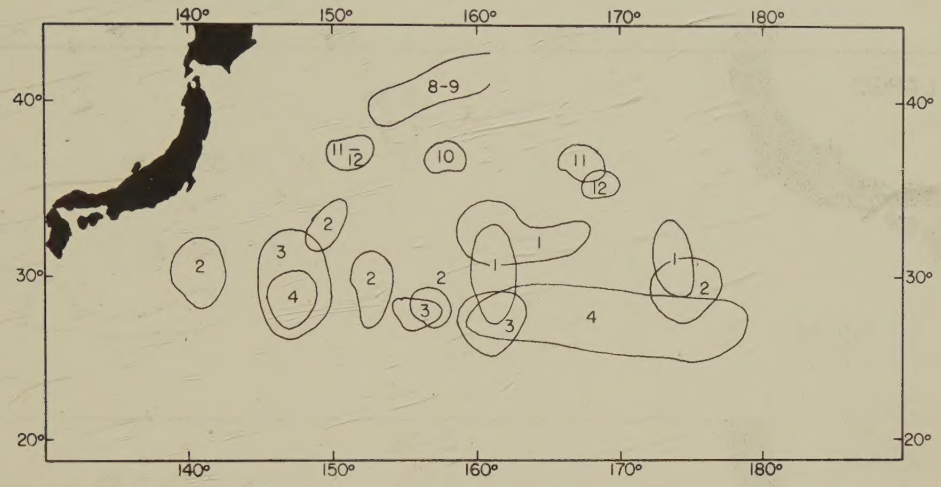
This is the hypothesis offered at present, however, these problems will be greatly clarified, it is believed, by tagging experiments, physiological investigation of spawning, investigation of the summer habitat of the fish, and a study of the catch statistics from the point of view of age composition. (Technician Takeo Sasaki).

Surface Water Temperatures on the Offshore Grounds

for Winter Albacore

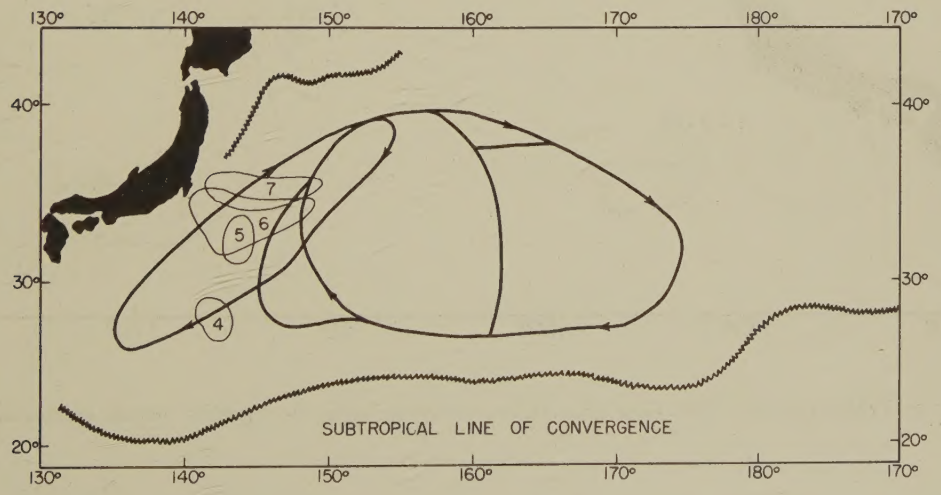
Year	Month	Favorable Water Temperatures	Water Temperatures at Which Fish Were Taken
1934	Jan.	16° - 19°	15° - 24°
	Feb.	17 - 19	16 - 24
	Mar.	17 - 19	15 - 22
	Apr.	18 - 19	
	Nov.	17 - 19	16 - 22
	Dec.	17 - 19	16 - 23
1935	Jan.	17 - 18	16 - 23
	Feb.	17 - 19	16 - 21
	Mar.	17 - 19	16 - 22
	Nov.	17 - 19	16 - 23
	Dec.	17 - 19	15 - 24
1936	Jan.	17 - 19	16 - 22
	Feb.	17 - 19	15 - 21
	Mar.	18 - 20	16 - 22
	Nov.	17 - 19	16 - 22
	Dec.	17 - 19	16 - 22
1937	Jan.	17 - 19	15 - 20
	Feb.	18 - 20	17 - 20
	Mar.	18 - 30	18 - 21
	Nov.	17 - 19	16 - 23
	Dec.	17 - 19	15 - 20

Sketch map of the fishing grounds of the winter albacore fishery (coastal and offshore).



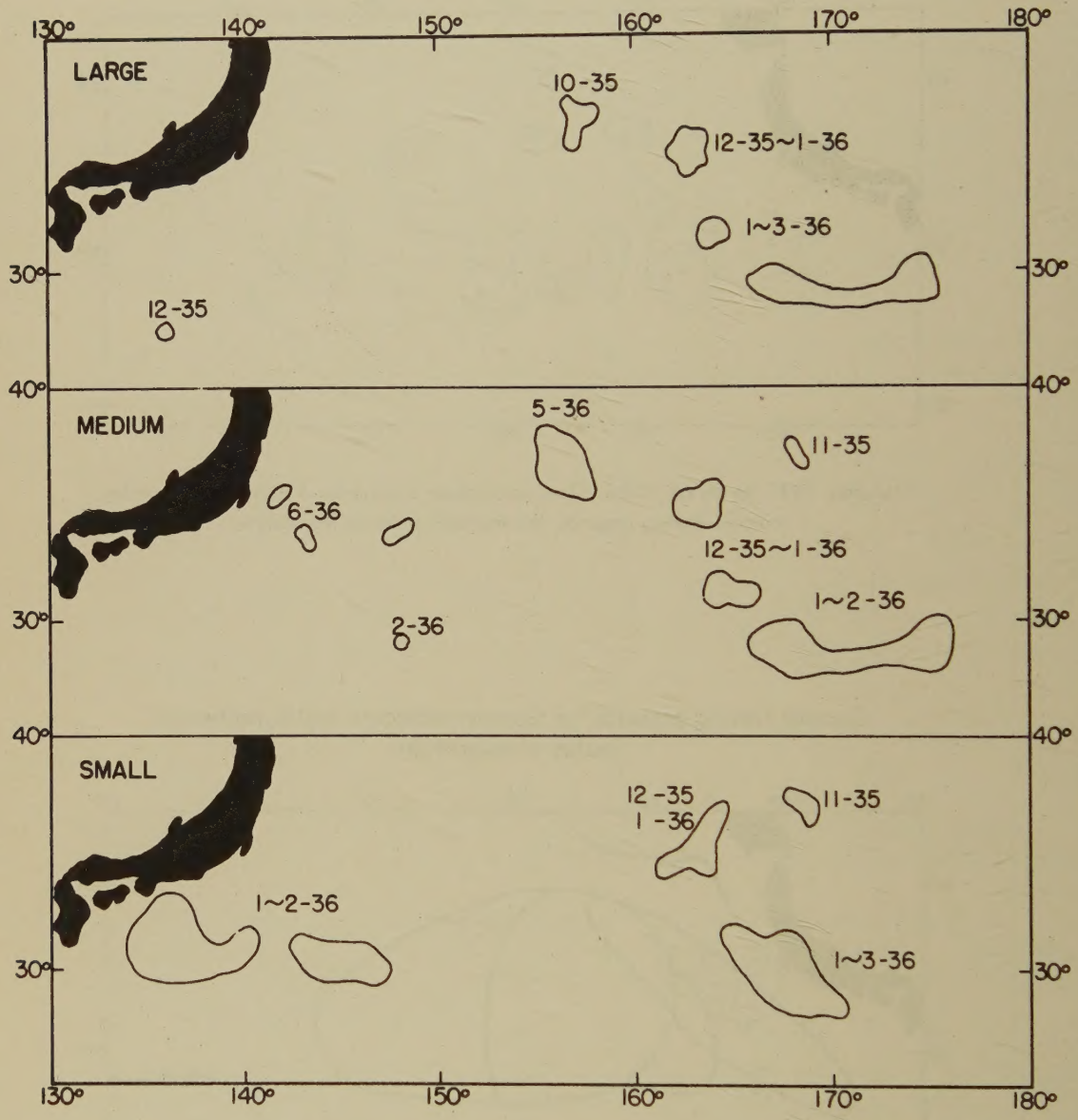
(Autumn, 1935, to spring, 1936. Does not include areas west of Zunan.) The circles indicate fishing grounds, the numbers indicate the months.

Coastal fishing grounds for summer albacore and hypothetical routes of migration.



(Fishing grounds are those for autumn, 1935, to spring 1936. Areas to the west of Zunan are not included.)

Sketch map of the fishing grounds for large, medium, and small albacore.



Autumn, 1935, to spring, 1936. The lines enclose fishing grounds, the numbers indicate months and years.